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ABSTRACT

Trends in enrollments and degrees for physics and astronomy students are examined, based on results of the American Institute of Physics' annual Survey of Enrollments and Degrees. Information is included on: changes in the number of institutions that grant physics degrees, physics degrees awarded by academic year, 1971-1982; undergraduate and graduate enrollments and degrees by institution type, 1971-1983; introductory physics enrollments in physics-degree-granting institutions by geographic region, 1978-1983; introductory physics enrollments, 1982-1983; undergraduate physics majors by geographic region and type of institution, 1982-1983; full- and part-time graduate enrollment by type of institution, 1973-1983; trends in U.S. and foreign graduate physics students, 1973-1983; unfilled assistantships for first-year graduate physics students, September 1982; number of physics degrees granted by sex and minority group status, 1981-1982; and trends in astronomy enrollment and degrees, 1975-1983. The data indicate that with the exception of doctorates, the numbers of 1981-1982 physics degrees conferred increased. Introductory astronomy courses attract large numbers of students, although the number of astronomy majors is small. (SW)

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ENROLLMENTS AND DEGREES

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AIP report MANPOWER STATISTICS DIVISION

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ENROLLMENTS AND DEGREES

by Susanne D. Ellis

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With the start of the 1980's, physics enrollments and degrees appeared to end their long decline and began to increase again. The same observation cannot be made about enrollments and degrees in astronomy. This report is based on AIP's oldest uninterrupted annual survey, the Survey of Enrollments and Degrees, which has the distinction of summarizing the data from nearly 100% of the 786 degree-granting physics and astronomy departments.

Table I presents recent changes in the numbers of institutions that grant physics degrees and shows the largest decline in doctoral programs in one year. Two of the six universities terminated their graduate physics programs entirely and retain only their undergraduate degree programs, whereas the remaining four institutions continue to offer a master's degree in physics. Fluctuations in the number of master's degree programs involve many institutions which have either very few or no graduate students enrolled, but whose administrations are in favor of keeping a master's degree program on the books. Three factors contributed to the gradual decline in bachelor's-granting institutions over the most recent five-year period: (1) gains from institutions which gave up their graduate programs, (2) a reduction from the more than twenty colleges which terminated their undergraduate physics degree programs, and (3) a small increase from a few new physics degree programs.

Table I. Institutions by highest physics degree offered, 1978–83.

Academic year	Doctorate granting	Master's granting	Bachelor's granting
1978–79	170*	104	502
1979–80	169*	96	501
1980–81	168*	103	492
1981–82	167**	104	485
1982–83	161**	95	488

Five of these institutions have two physics doctorate-granting departments; the second one is generally an applied physics department. They are Stanford U., U. of CA-Davis, U. of CA-San Diego, Harvard U., and Cornell U.

***Four of these institutions have two physics doctorate-granting departments. They are Stanford U., U. of CA-Davis, Harvard U., and Cornell U.*

By making a distinction between a terminal master's degree and one granted enroute to a higher physics degree, we are able to present four trends in **Figure I.** With the exception of doctorates, the numbers of 1981–82 physics degrees conferred indicate definite increases.

Fig. I. Physics degrees awarded by academic year, 1971–82

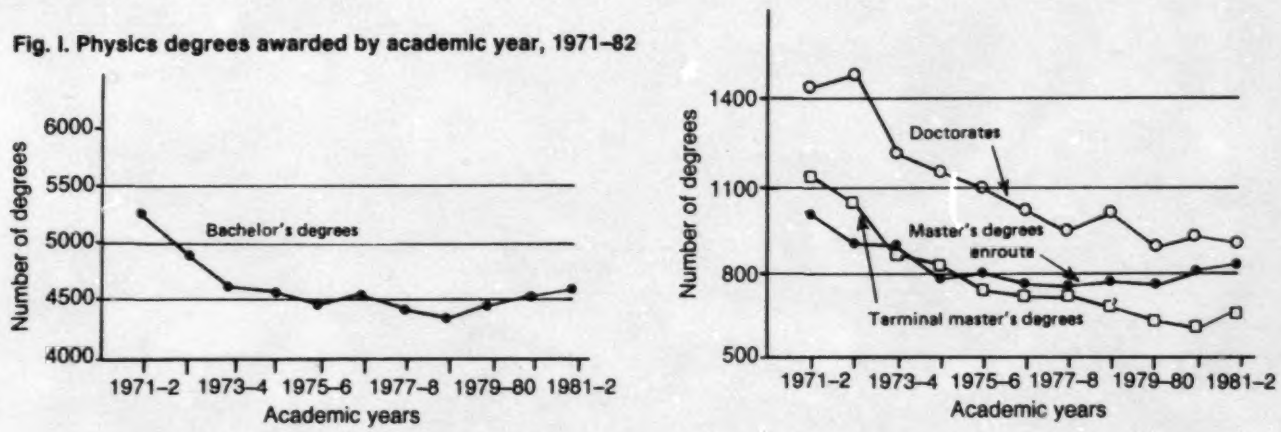

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Table II. Physics enrollments and degrees awarded by academic year 1971–83

Academic year	Number of physics degrees granted (July 1 to June 30)			Undergraduate physics-major enrollment		Graduate physics-student enrollment*	
	Bachelor's	Master's	Doctor's	Juniors	Seniors	Total	1st year
1971–72	5282	2143	1438	6593	6162	13 276	3336
1972–73	4923	1961	1445	6012	5806	11 804	2904
1973–74	4652	1772	1236	5858	5106†	11 119	2680
1974–75	4571	1650	1167	5660	4909†	10 410	2668
1975–76	4487	1570	1111	5888	4922†	10 372	2646
1976–77	4517	1469	1051	5711	4930†	9 991	2624
1977–78	4457	1422	971	5820	4975††	9 835	2499
1978–79	4416	1428	1033	5835	4964	9 813	2458
1979–80	4440	1370	912	5696	4942	9 647	2439
1980–81	4513	1387	927	5905	5091	9 934	2564
1981–82	4558	1476	912	6386	5372	10 173	2637
1982–83				6299	5580	10 429	2630

*Includes part-time students.
†This total has been adjusted by 500 for students who are seniors for more than one year.
††This total has been adjusted by 300 students who are seniors for more than one year.

Table III. Undergraduate and graduate enrollments and degrees by institution type, 1971–83

Academic year	Number of physics degrees granted (July 1 to June 30)			Undergraduate physics-major enrollment		Graduate physics-student enrollment*	
	Bachelor's	Master's	Doctor's	Juniors	Seniors	Total	1st year
			Doctorate granting institutions				
1971–72	2502	1640	1438	3082	2987	11 434	2449
1972–73	2265	1484	1445	2787	2717	10 227	2177
1973–74	2155	1387	1236	2844	2484	9 759	2169
1974–75	2191	1318	1167	2780	2420	9 295	2205
1975–76	2182	1249	1111	2983	2505	9 241	2163
1976–77	2184	1186	1051	2862	2502	8 867	2182
1977–78	2218	1164	971	2851	2590	8 852	2138
1978–79	2158	1183	1033	2937	2579	8 864	2107
1979–80	2142	1151	912	2696	2491	8 744	2072
1980–81	2123	1161	927	2765	2568	9 062	2223
1981–82	2179	1281	912	2996	2671	9 273	2275
1982–83				2962	2645	9 524	2288
			Master's granting institutions				
1971–72	982	503		1238	1210	1842	887
1972–73	820	477		1145	1086	1577	727
1973–74	810	385		939	893	1360	511
1974–75	699	332		881	741	1115	463
1975–76	604	321		916	811	1131	483
1976–77	658	283		840	761	1078	442
1977–78	590	258		832	752	983	361
1978–79	541	245		795	694	949	351
1979–80	585	219		705	650	903	367
1980–81	589	226		868	655	872	341
1981–82	532	195		917	734	900	362
1982–83				877	752	905	342
			Bachelor's granting institutions				
1971–72	1798			2273	1965		
1972–73	1838			2080	2003		
1973–74	1687			2075	1731		
1974–75	1681			1999	1748		
1975–76	1701			1989	1606		
1976–77	1675			2009	1667		
1977–78	1649			2137	1633		
1978–79	1717			2103	1691		
1979–80	1713			2295	1801		
1980–81	1801			2272	1868		
1981–82	1847			2473	1967		
1982–83				2460	2183		

Table IV. Introductory physics enrollments in physics-degree-granting institutions by geographic region 1978–1983

Geographic region†	1978–79	1979–80	1980–81	1981–82	1982–83
New England	19 356	18 797	21 766	20 228	19 124
Mid Atlantic	42 652	41 555	43 216	41 879	45 236
E. N. Central	50 434	50 843	54 663	54 430	54 410
W. N. Central	21 115	21 805	23 406	23 420	25 776
S. Atlantic	33 097	33 966	33 800	36 544	36 750
E. S. Central	14 835	14 829	15 068	16 276	14 712
W. S. Central	26 768	28 563	30 030	28 188	28 980
Mountain	19 342	20 753	21 035	23 408	25 966
Pacific	32 084	31 318	36 150	34 656	36 076
Total	259 683	262 429	279 134	279 029	287 030

†New England–Conn., Me., Mass., N. Hamp., R.I., Vt.; Middle Atlantic–N.J., N.Y., Pa.; East North Central–Ill., Ind., Mich., Ohio, Wisc., West North Central–Iowa, Kansas, Minn., Mo., Nebr., N. Dak., S. Dak.; South Atlantic–Del., D.C., Fla., Ga., Md., N.C., S.C., Va., W. Va.; East South Central–Ala., Ky., Miss., Tenn.; West South Central–Ark., La., Okla., Tex.; Mountain–Ariz., Colo., Idaho, Mont., Nev., N. Mex., Utah, Wyo.; Pacific–Alas., Cal., Hawaii, Oreg., Wash.

The numerical degree data on which **Figure I** is based are presented in **Table II** together with undergraduate and graduate enrollment trends. One year ago the total graduate physics enrollment once again climbed above the ten thousand mark, and this year's total indicates a further increase to a level not attained since 1974–75. Undergraduate junior physics majors appear to level off as seniors reflect the earlier increases in juniors.

In order to reconcile the declining number of physics degree programs presented in **Table I** with the increasing enrollment and degree trends of **Table II**, we require **Table III** which shows the extent to which physics students are attracted to the doctorate-granting institutions. This table analyzes the composite totals shown in **Table II** by dividing the enrollments and degrees between types of institutions. For example, the 6% increase in master's degrees for the most recent year consists of a 10% increase at the doctoral institutions offset by a 14% decrease at the master's institutions. Similarly, total graduate enrollment increased primarily at the large universities and not at the master's institutions; furthermore, first-year graduate students actually declined there by 5%.

Thus, the first three tables and **Figure I** of this report present an overview of physics enrollment and degree trends, allowing **Tables IV** through **XI** to focus on more detailed analyses of the pipeline, and **Tables XII** and **XIII** to present the corresponding astronomy data.

Introductory physics enrollments

Since physics is not widely incorporated into secondary school curricula in the U.S., many students encounter this discipline for the first time as freshmen in college. Also physics is frequently the science requirement for engineering, physical science or health-related majors. For those reasons enrollments in introductory physics exceed a quarter of a million and appear to have grown as shown in **Table IV**. An increase can be observed in most of the geographic regions with the exception of New England and the East-South-Central states.

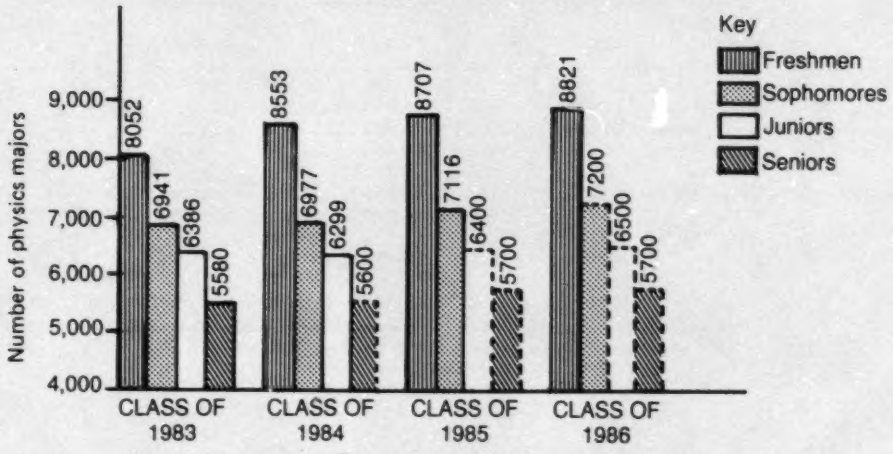
Through examination of the introductory physics enrollments by type of institution and with respect to the design of the course, the totals in **Table V** represent increases at the bachelor's and master's institutions, largely to be attributed to increases in prospective engineering majors.

Table V. Introductory physics enrollments, 1982–83.

Enrollment in introductory physics courses designed for:	Institution type* I N	I %	II N	II %	III N	III %	Total N	Total %
engineering majors	23 073	31.4	14 375	31.9	74 134	44.0	111 582	38.9
physical science majors	13 814	18.8	8 202	18.2	27 126	16.1	49 142	17.1
biology, health-related majors	21 089	28.7	13 654	30.3	41 279	24.5	76 022	26.5
other	15 504	21.1	8 833	19.6	25 947	15.4	50 284	17.5
Total introductory N	73 480		45 064		168 486		287 030	
enrollment %	25.6		15.7		58.7			100.0

*"Institution type" indicates the highest degree offered; type I = bachelor's degree, type II = master's degree, type III = doctorate.

Fig. II. Actual and projected number of undergraduate physics majors



Note: Each cluster of bars shown in Figure II depict the freshmen, sophomores, juniors, and seniors of four successive graduating classes. The most recent estimate of freshmen physics majors is 8821 and refers to September 1982. Based on the attrition of earlier classes 5700 of them are expected to become senior physics majors in 1985–86 and are presented above as the "class of 1986".

Undergraduate physics majors

At most institutions students are not required to declare their majors until the beginning of the junior year. However, taking into account the requirements for a physics bachelor's degree, the great majority of physics department chairmen estimate, with considerable accuracy, the numbers of freshmen and sophmores who are likely to be physics majors in their departments. The attrition rates between freshmen and seniors have been monitored closely, making it possible to project classes of senior physics majors until 1986. Thus the first set of bars in **Figure II** follows the 1979–80 freshman physics majors through four years of undergraduate study to become the graduating class of 1983. Last September's estimate of freshman physics majors is projected to yield 5700 seniors in the fall of 1985.

Table VI presents greater detail on the enrollment of undergraduate physics majors by showing their distribution in nine regions of the U.S. The last column of this table "Fifth-year undergraduates," consists of over 500 students who need an additional summer session or term to complete their degree requirements; in some cases transfers from junior colleges cause such a delay. Thus, by separating those 565 seniors from the others, physics majors at each level are counted only once.

Using the totals for seniors presented in the lower portion of **Table VI** and comparing them with the freshman physics majors of 1979–80, we find that at the two types of graduate institutions the seniors comprise approximately 75% of the freshmen, whereas at bachelor's-granting institutions only 63% of the freshmen appear to have become senior physics majors.

Table VI. Undergraduate physics majors by geographic region and type of institution, 1982–1983.

Geographic region*	Estimated** no. of freshmen	Estimated** no. of sophomores	Number of juniors	Number of seniors	Fifth-year undergraduates
New England	711	658	616	567	44
Mid Atlantic	1 832	1 331	1 062	875	73
E. N. Central	1 291	1 050	946	878	78
W. N. Central	733	583	493	444	20
S. Atlantic	1 303	985	892	718	77
E. S. Central	378	298	272	260	34
W. S. Central	726	624	486	454	39
Mountain	600	541	407	458	44
Pacific	1 247	1 046	1 125	926	156
Total	8 821	7 116	6 299	5 580	565
Doctorate-granting inst.	3 962	3 157	2 962	2 645	259
Master's-granting inst.	1 267	970	877	752	105
Bachelor's-granting inst.	3 592	2 989	2 460	2 183	201

** See Table IV for explanation of geographic region.*
***Estimates of potential physics majors made by the physics department chairmen.*

Graduate enrollment

A topic of major interest in recent years has been the influx of foreign students to U.S. universities. Traditionally physics has been a discipline which attracted a relatively large number of foreign students, especially at the graduate level. But over the past ten years, the proportion of foreign first-year graduate physics students nearly doubled. **Table VII** presents a ten-year trend both of U.S. and foreign students, contrasting the former group's decline with the latter group's increases.

Table VIII focuses on the total graduate physics student population and presents their study status. As in evident from the trends in that table, master's institutions have always enrolled a large proportion of part-time graduate students, whereas at doctoral departments part-time students comprise less than 10% since 1975–76.

Three years ago we started asking graduate physics department chairmen about unfilled assistantships for first-year graduate students. We analyzed these data with respect to nine geographic regions, because the distribution of these sources of support is by no means uniform. **Table IX** presents the responses from both doctoral and master's departments and shows the number of first-year graduate students to provide a frame of reference. For example, the region with the largest first-year graduate enrollment is the Pacific with 438 students and only one PhD-department with nine unfilled assistantships; at the other extreme is the East-South-Central region with only 63 first-year students and seventeen unfilled assistantships. The total number of unfilled assistantships at doctoral departments has declined to half of what it was in September 1979. The first-year graduate enrollment at master's institutions could have been 20% larger if all the assistantships had been filled.

Table VII. Trend in entering U.S. and foreign graduate physics students, 1973–83.

Academic year	No. of first-year graduate students U.S.	Foreign	Total	% foreign students of total
1973–74	2066	614	2680	22.9
1974–75	2074	594	2668	22.3
1975–76	2095	551	2646	20.8
1976–77	1987	637	2624	24.2
1977–78	1851	648	2499	26.0
1978–79	1840	618	2458	25.2
1979–80	1700	739	2439	30.3
1980–81	1720	844	2564	32.9
1981–82	1654	983	2637	37.3
1982–83	1576	1054	2630	40.1

Table VIII. Full-time and part-time graduate physics enrollment by type of institution, 1973–83

Academic year	Total number of graduate students Institution type* II Full-time	Part-time	Sub-total	III Full-time	Part-time	Sub-total	Total
1973–74	734	626	1360	8810	949	9759	11119
1974–75	623	492	1115	8326	969	9295	10410
1975–76	628	503	1131	8439	802	9241	10372
1976–77	576	507	1083	8119	789	8908	9991
1977–78	546	437	983	8174	678	8852	9835
1978–79	468	481	949	8185	679	8864	9813
1979–80	550	353	903	8059	685	8744	9647
1980–81	484	388	872	8302	760	9062	9934
1981–82	543	357	900	8555	718	9273	10173
1982–83	566	339	905	8712	812	9524	10429

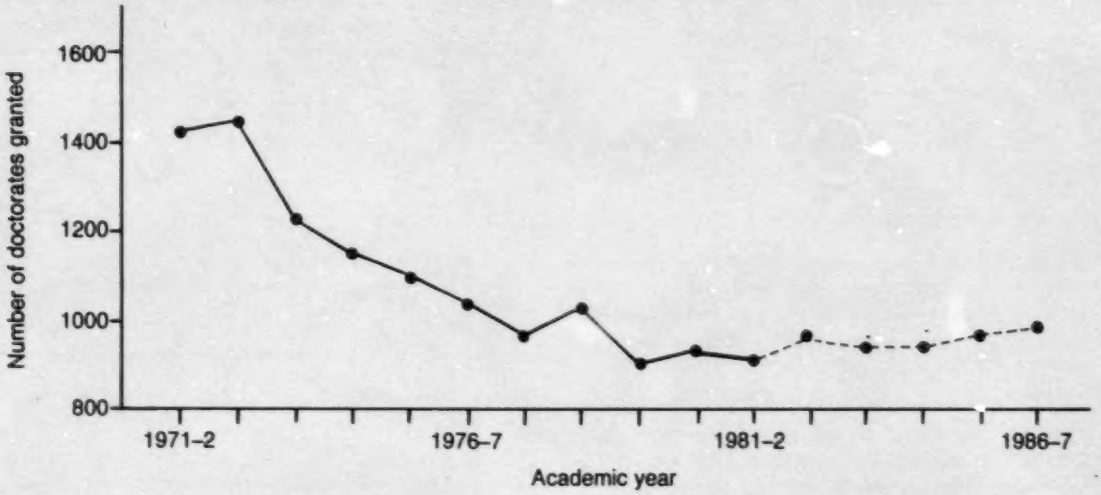
**Institution type indicates the highest physics dgree offered: type II = master's degree, type III = doctorate.*

Table IX. Unfilled assistantships for first-year graduate physics students, September 1982.

Geographic region*	Doctoral departments with 0 unfilled	1–2	3–5	>6 assistantships	No. of unfilled ass'tships	No. of 1st yr. grad. students	Master's-granting depts. with 0 unfilled	1–2	3–5 assistantships	No. of unfilled ass'tships	No. of 1st yr. grad. students
New England	13	3	1	0	8	286	2	0	1	4	18
Mid Atlantic	22	1	2	0	8	413	3	0	2	7	14
E. N. Central	13	2	0	1	9	406	9	3	2	11	110
W. N. Central	8	1	2	0	8	110	7	4	0	5	36
S. Atlantic	16	4	1	0	9	244	4	3	1	9	28
E. S. Central	3	1	4	0	17	63	2	2	3	14	25
W. S. Central	8	3	0	1	13	183	2	4	3	13	41
Mountain	6	1	4	1	23	145	3	2	0	2	14
Pacific	18	0	0	1	9	438	3	4	1	10	56
Total					104	2 288				75	342

**See Table IV for explanation of geographic region.*
Note: 24 doctorate-granting and 25 master's-granting departments did not answer the question on unfilled assistantships.

Fig. III. Actual and projected number of physics doctorates granted, 1971–1987



There has been no change in over a decade in the median number of years of graduate study required to complete a physics doctorate; it is five years and has a range from three to more than ten years. The high correlation between the first-year graduate students at PhD-granting institutions and the number of doctorates granted five years later is the basis for our projection presented in **Figure III**. In recent years, between 42% and 45% of a given year's entering graduate students complete their doctorate five years later. Since the rapid increase in foreign graduate students began less than five years ago, it is still not known what possible changes may occur in the attrition rate or what is the median number of years required to complete a physics doctorate. Therefore the expected number of physics PhD's to be conferred during the mid to late 1980's remains in the range of 950 to 1000 per year.

Degrees granted

From **Figure I** it is clear that master's degrees are increasing. But **Table X** provides the details regarding which regions of the U.S. and which types of institutions are major contributors to the production of new physicists. This table shows that both master's enroute and terminal master's degrees are granted by doctoral as well as master's institutions. However, a comparison with the previous year attributes the increased degree productions only to the PhD-granting institutions. In particular, master's institutions designated as Type II granted 22% fewer master's degrees enroute and 10% fewer terminal master's degrees. The geographic distribution of doctorates granted in 1981–82 registered a 27% increase in the South Atlantic region as other regions recorded only small changes.

Table X. Physics degrees by type of institution and geographic region, 1981–82.

	Bachelor's degrees			Master's degrees		Terminal master's degrees		Doctorates
Geographic region*	Institution type** I	II	III	Institution type** II	III	Institution type** II	III	Institution type** III
New England	125	44	356	10	98	7	51	135
Mid. Atlantic	354	39	392	1	172	15	75	190
E. N. Central	316	132	264	17	142	43	113	153
W. N. Central	188	43	109	3	22	17	21	53
S. Atlantic	283	59	260	4	77	13	64	107
E. S. Central	104	50	57	3	18	8	6	17
W. S. Central	149	64	162	8	46	14	37	66
Mountain	81	24	178	1	33	2	33	43
Pacific	247	77	401	10	174	19	99	148
Subtotal	1 847	532	2 179	57	782	138	499	912
				839		637		
Total		4 558			1 476			912

**See Table IV for explanation of geographic region.*

***Institution type indicates the highest physics degree offered; type I = bachelor's degree, type II = master's degree, type III = doctorate.*

Table XI. Number of physics degrees granted by sex and minority group* status, 1981–82.

Type of degree	Sex	Total no. of degrees	Black	Am. Ind.	Puerto Rican	Mex. Am.	Hispanic	Oriental	Asian Ind.	Arab	Total minorities
Bachelor's	Men	4025	96	6	3	14	24	66	8	37	254
	Women	533	26	0	0	2	2	13	3	5	51
	Total	4558	122	6	3	16	26	79	11	42	305
Master's enroute	Men	759	10	0	1	0	8	36	6	6	67
	Women	80	1	0	0	0	0	12	3	2	18
	Total	839	11	0	1	0	8	48	9	8	85
Terminal master's	Men	553	10	1	0	1	4	18	8	13	55
	Women	84	2	0	0	0	0	6	3	0	11
	Total	637	12	1	0	1	4	24	11	13	66
Doctorate	Men	849	15	1	1	1	11	56	33	14	132
	Women	63	1	0	0	0	4	8	3	0	16
	Total	912	16	1	1	1	15	64	36	14	148

**Minorities in AIP surveys are defined as groups with a low representation in the physics community, but ones whose participation has aroused considerable interest.*

Closely tied to the data we collect and analyze on foreign student participation in physics programs, are our data on minority groups. We define minority groups as those who have a small but noted representation among the physics degree recipients; hence it appeared appropriate to include women in **Table IX** which focuses on the most recent academic year, 1981–82, of physics degree recipients irrespective of citizenship. The sources for this information are: (1) a report of women and minority degree recipients from physics department chairmen, and (2) identification with minority groups by individual graduates. The second source forms part of two student surveys* conducted annually by AIP.

At the beginning of this report we mentioned the exceptionally high response rate to the Survey of Enrollments and Degrees whose data form the basis of the major part of this report. However, an exceptionally high response to the minority questions was not observed. For that reason one needs to view the numbers of minority degree recipients at all levels as lower limits.

* *"Survey of Physics and Astronomy Bachelor's Degree Recipients," AIP Pub. No. R-211.13*
"Graduate Student Survey," AIP Pub. No. R-207.14.

ASTRONOMY

Although astronomy is not considered an interdisciplinary area of study, difficulties of definition arise when graduate astronomy students are granted physics degrees by several of the 31 combined physics and astronomy departments. In the early 1970's, the annual Survey of Enrollments and Degrees was expanded to include astronomy data and to limit itself to the "degree-granting astronomy departments" of which there were approximately 70. Thus definitional problems occur in reporting graduate astronomy enrollment especially where trend data are concerned.

According to the data presented in **Table XII**, at the undergraduate level, astronomy majors appear to experience a recent increase after a long decline. The decrease in doctorates granted may be real or it may simply reflect the definitional problems mentioned above rather than a 35% decrease over the past two years.

Table XII. Trend in astronomy enrollments and degrees, 1975–1983

	No. of astronomy degrees granted (July 1–June 30)							
					Undergraduate astronomy major enrollment		Graduate astronomy enrollment	
Academic year	Bachelor's	Master's enroute	Terminal master's	Doctor's	Juniors	Seniors	Total	1st year
1975–76	172	56	35	93	305	280	780	165
1976–77	184	58	35	96	290	270	790	170
1977–78	177	64	31	93	295	270	803	171
1978–79	165	42	42	90	270	249	710	145
1979–80	165	27	27	106	262	242	698	154
1980–81	156	34	24	82	275	238	686	164
1981–82	181	54	15	70	252	224	647	142
1982–83					274	232	670	178

Table XIII. Astronomy* enrollments 1982–83 and degrees 1981–82 by type of institution**

		Type I	Type II	Type III	Total
Astronomy Departments	Combined	18	3	10	31
	Separate	5	3	30	38
	Total	23	6	40	69
Astronomy Degree's	Bachelor's	37	16	128	181
	Master's enroute	–	3	51	54
	Terminal master's	–	3	12	15
	Doctor's	–	–	70	70
Astronomy Enrollments	Introd. courses for science majors	791	75	2 131	2 997
	Introd. courses for nonscie. majors	5 270	1 833	34 008	41 111
	Introd. astronomy courses offered in physics departments	–	–	–	57 099
	Total introductory enrollments				101 207
	Junior astronomy majors	54	29	191	274
	Senior astronomy majors	56	21	155	232
	First-year graduate students	–	23	155	178
	Total graduate enrollment	–	35	635	670

**This survey includes only degree-granting astronomy departments.*

***"Institution type" indicates the highest astronomy degree offered; type I = bachelor's degree, type II = master's degree, type III = doctorate.*

While the number of astronomy majors as well as graduate students remain comparatively small, introductory astronomy courses attract a large number of students and are offered in both astronomy and physics departments. As indicated in **Table XIII**, the introductory astronomy enrollment in the physics and astronomy degree-granting institutions only, is over 100,000.

For purposes of comparison with physics the 69 astronomy departments are divided into three groups on the basis of highest astronomy degree offered and their enrollments and degrees are classified accordingly. Comparing the data in **Table XIII** with those of the previous year, we note increased enrollments at the bachelor's and doctoral institutions.

Additional publications available from the Manpower Statistics Division are:

Graduate Student Survey
Employment Survey
Survey of Physics and Astronomy Bachelor's Degree Recipients